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TITLE: Web cleaner apparatus and method

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An apparatus and method for cleaning a moving web of sheet material. The
apparatus includes a **Coanda** nozzle having an elongated, curved foil and a slit
for directing gas at a high rate of speed along the foil. The gas from the
foil impacts a layer of air entrained by the web of sheet material flowing in
an opposed direction. Impact occurs within a gap formed between the foil and
the web which becomes increasingly restricted in the direction of movement of
the web. The entrained layer of air is caused to reverse direction within the
gap and is mixed with the gas from the nozzle under turbulent conditions to
clean the web and remove particulate material such as dust therefrom.

It will be appreciated that dust and other particles must be quickly and
positively removed from fast moving webs such as those found in paper making
and paper conversion facilities. The arrangement of the present invention
accomplishes this objective in a highly efficient, relatively low cost manner.
One of the components of the present system is a **Coanda** nozzle of specialized
construction which is positioned relative to the web in a particular manner
which provides a highly turbulent interface between air flow from the nozzle
and the entrained layer of air moving with and bordered by the moving web.

While it is known generally to deploy one or more **Coanda** nozzles along the path of a moving web to treat the web in some manner or direct movement of the web, the arrangement of the present invention incorporates structure and method steps which cooperate in a unique manner to effectively and positively clean even very fast moving webs.

The apparatus is for cleaning the substantially planar surface and includes a **Coanda** nozzle comprising an elongated, curved foil and slit defining means defining an elongated, narrow slit with the elongated, curved foil.

The **Coanda** nozzle is positioned closely adjacent to the substantially planar surface of a moving web of sheet material with the downstream location of the elongated, curved foil being further from the substantially planar surface than is the elongated, curved foil intermediate location whereby the elongated, curved foil forms a gap with the moving web substantially planar surface which becomes increasingly restricted in the predetermined direction and within which a layer of air entrained by the moving web of sheet material is impacted by gas flowing at a high rate of speed along the curved foil in a direction generally opposed to the predetermined direction, mixed with the gas under turbulent conditions and caused to substantially reverse direction away from the curved foil.

The apparatus additionally comprises an air discharge chute and means for applying a vacuum to the air discharge chute to direct the mixture of gas and entrained air layer to a location away from the **Coanda** nozzle. The discharge chute includes a curved, discharge plate adjacent to the elongated, curved foil and curving away from the **Coanda** nozzle.

The curved discharge plate has an elongated entry end located at the **Coanda** nozzle and extending along the length of the **Coanda** nozzle. The curved discharge plate elongated entry end is offset from the elongated, curved foil downstream location along the length of the **Coanda** nozzle and located further away from the substantially planar surface of a moving web when the **Coanda** nozzle is adjacent thereto than is the elongated, curved foil downstream location to promote turbulence of the gas and entrained air layer in the gap.

The apparatus 20 of the present invention includes a **Coanda** nozzle having an elongated, curved foil 22 and a housing 24 defining an elongated, narrow slit 26 with the elongated, curved foil. The interior of housing 24 is connected to a source of pressurized air or other gas.

The pressurized air or other gas exits slit 26 at a high rate of speed, attaching itself to the elongated, curved foil 22 as a result of the **Coanda** effect. Such gas movement will also serve to entrain ambient air at the location of the **Coanda** nozzle whereby the gas and ambient air entrained thereby will move from the upstream location on the foil located at the slit and past an intermediate location on the foil closely adjacent to the moving web to a downstream location at the end 28 of the elongated, curved foil.

The apparatus of the present invention also includes an air discharge chute 34 which is utilized to direct the gas and particulate mixture away from the **Coanda** nozzle to a predetermined location. For example, the mixture may be directed to a filter (not shown) for filtering out the particulates. Preferably, a vacuum is applied to the air discharge chute

by an exhaust blower
or other suitable vacuum means to ensure transport of the gas-particulate
mixture to the desired remote location.

Discharge chute 34 includes a curved, discharge plate 36 adjacent to the
elongated, curved foil 22 and curving away from the **Coanda** nozzle. The curved,
discharge plate 36 has an elongated entry end 38 located at the **Coanda** nozzle
and extending along the length of the **Coanda** nozzle. The curved, discharge
plate elongated entry end 38 is offset from the elongated, curved foil
downstream location along the length of the **Coanda** nozzle and located further
away from the substantially planar surface of the moving web than is the
elongated, curved foil downstream location 28. It has been found that such an
arrangement promotes turbulence of the gas, entrained ambient air, and
entrained air layer in the gap. In turn, this contributes to the cleaning
efficiency of the apparatus.

The **Coanda** nozzle and air discharge chute extend all the way across the web of
sheet material from edge 12 to edge 14. That is, the primary axis of the
Coanda nozzle is disposed at substantially right angles to the predetermined
direction of the web.

For efficient operation of the apparatus, the elongated, narrow slit 26 has a
uniform width within the range of from about 0.002 inches to about 0.02 inches,
and even more preferably a width of about 0.01 inch. It is also important that
the compressed gas employed for operation of the **Coanda** nozzle is pressurized
within a range of from about 2 psig to about 10 psig prior to flow thereof
through the slit. Even more preferably, the compressed gas has a pressure of
about 5 psig.

a **Coanda** nozzle including an elongated, curved foil and slit defining means defining an elongated, narrow slit with said elongated, curved foil, said elongated, narrow slit for receiving a compressed gas and directing said gas at a high rate of speed along said elongated, curved foil from an upstream location on said elongated, curved foil and past an intermediate location on said elongated, curved foil to a downstream location at an end of said elongated, curved foil, said **Coanda** nozzle for positioning closely adjacent to the substantially planar surface of a moving web of sheet material with the downstream location on said elongated, curved foil being further from the substantially planar surface than is the elongated, curved foil intermediate location whereby said elongated, curved foil forms a gap with said moving web substantially planar surface which becomes increasingly restricted in the predetermined direction and within which a layer of air entrained by said moving web of sheet material is impacted by gas flowing at a high rate of speed along said curved foil in a direction generally opposed to said predetermined direction, mixed with said gas under turbulent conditions, and caused to substantially reverse direction away from said curved foil; and

an air discharge chute and means for applying a vacuum to said air discharge chute to direct the mixture of gas and entrained air layer to a location away from said **Coanda** nozzle, said discharge chute including a curved discharge plate adjacent to said elongated, curved foil and curving away from said **Coanda** nozzle.

2. The apparatus according to claim 1 wherein said **Coanda** nozzle has a primary

axis at least about equal to the distance between the spaced edges of said web
of sheet material, said **Coanda** nozzle having the primary axis thereof disposed
at substantially right angles to said predetermined direction when said **Coanda**
nozzle is positioned closely adjacent to the substantially planar surface of a
moving web of sheet material whereby said **Coanda** nozzle extends between the
spaced edges of said moving web and across substantially the full width of said
web.

3. The apparatus according to claim 1 wherein said curved discharge plate has
an elongated entry end located at said **Coanda** nozzle and extending along the
length of said **Coanda** nozzle, said curved discharge plate elongated entry end
being offset from said elongated, curved foil downstream location along the
length of said **Coanda** nozzle and located further away from the substantially
planar surface of a moving web when said **Coanda** nozzle is adjacent thereto than
is said elongated, curved foil downstream location to promote turbulence of the
gas and entrained air layer in said gap.